

**LOG OF MEETING
DIRECTORATE FOR ENGINEERING SCIENCES**

SUBJECT: CPSC Electrical Wiring Activities

DATE OF MEETING: August 7, 2003

PLACE OF MEETING: Hilton Knoxville Airport
Alcoa, Tennessee

LOG ENTRY SOURCE: Doug Lee, ESEE

OK

DATE OF LOG ENTRY: August 19, 2003

COMMISSION ATTENDEES:

Doug Lee, ESEE

NON-COMMISSION ATTENDEES:

Michael Callanan- International Brotherhood of Electrical Workers (IBEW)

James Dollard- IBEW

Joseph Sheehan- National Fire Protection Association

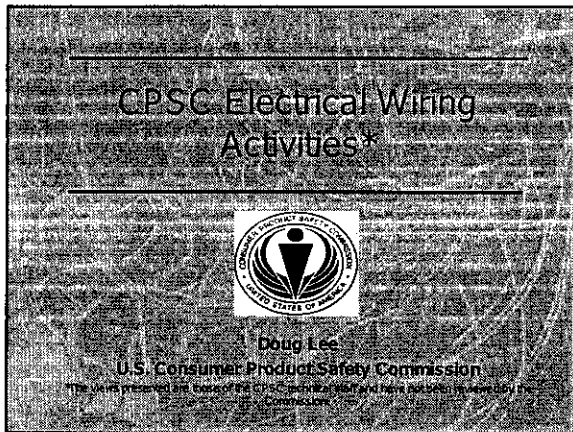
Michael Johnston- International Association of Electrical Inspectors

About 40 IBEW *National Electrical Code* code panel members (principals and alternates)

SUMMARY OF MEETING:

Mr. Lee met with the IBEW code panel members to present and discuss CPSC electrical wiring activities. Attached is the CPSC staff presentation.

6 (b) CLEARED: 8-20-03
_____☒ No Mfrs Identified
_____☐ Excepted
_____☐ Mfrs Notified
_____☐ Comments Processed



OUTLINE

- About the U.S. Consumer Product Safety Commission (CPSC)
- Electrical Wiring Activities
- Electrical Codes and Standards

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About CPSC - Background

- Independent Federal regulatory agency, established in 1973 under the Consumer Product Safety Act
- Jurisdictional Authority under 5 Acts
 - Consumer Product Safety Act (CPSA)
 - Federal Hazardous Substances Act (FHSA)
 - Flammable Fabrics Act (FFA)
 - Poison Prevention Packaging Act of 1970 (PPPA)
 - Refrigerator Safety Act (RSA)
- 3 Commissioners, appointed by the President and approved by the Senate

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CPSC - Budget/Staffing

- Total Budget - \$56 million in FY 2003
- About 470 staff
 - Headquarters (Bethesda, MD)
 - Field (throughout US)
 - Laboratory (Gaithersburg, MD)

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CPSC - Jurisdiction



15,000 types of consumer products

- | | |
|---|--|
| ▪ Electrical Appliances  | ▪ Children's Toys and Furniture  |
| ▪ Combustion Appliances  | ▪ Home Wiring  |
| ▪ Furniture and Home Accessories  | ▪ Fabrics, Materials and Accessories  |
| ▪ Sports and Recreational Equipment  | ▪ Powered Equipment and Tools  |
|  | ▪ And more...  |

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CPSC - Jurisdiction

Exceptions:

- | | |
|---|--|
| ▪ Tobacco products | ▪ Aircraft  |
| ▪ Medical devices | ▪ Firearms |
| ▪ Food and drugs | ▪ Pesticides |
| ▪ Automobiles | ▪ Cosmetics |
| ▪ Boats  | ▪ Workplace products |

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CPSC Functions

- Collect & Analyze Data
- Perform Applied Research
- Encourage Voluntary Standards
- Require Performance Safety Standards
- Require Safety Labeling
- Require Special Packaging
- Enforce regulations
- Recall Defective Products
- Ban Hazardous Products
- Inform Consumers

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CPSC Data Sources

- National Electronic Injury Surveillance System
- Death Certificates
- In-Depth Investigation Reports
- Injury/Potential Injury File
 - Hotline/website reports
 - Newspaper accounts
 - Other sources
- National Fire Incident Reporting System (NFIRS)

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CPSC Fire Loss Estimates

CPSC Epidemiology staff provides annual estimates of consumer product-related residential fire losses

- National Fire Protection Association (NFPA) conducts an annual survey of fire departments and, from this, estimates national residential structure fire losses
 - Does not include details on causes of fire ignition or product involvement

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CPSC Fire Loss Estimates

- U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) compiles reports completed by participating fire departments
 - Reports include coding that describes fire cause and product involvement
- CPSC staff applies the proportions of the product-related fires from NFIRS against the NFPA national fire estimates to estimate total product-related fire losses.

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CPSC Use of Data

- Define size of problem
 - set priorities, project decisions
- Characterize problem
 - design effective intervention
- Justify regulatory action
- Support recalls

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Major Causes of Home Fires

- (1) Cooking Equipment - 27.7 %
- (2) Heating Equipment - 14.3%
- (3) Arson - 11.4%
- (4) Electrical Distribution - 10.8 %
- (5) Open flame - 8.4%

- Source: National estimates based on NFIRS and NFPA survey, 1999 NFPA National Fire Escape Survey

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Major Causes of Home Fire Deaths - 1999

- Careless Smoking - 25.7%
- Arson - 18.6%
- Heating Equipment - 13.3%
- Cooking Equipment - 13.2%
- Electrical Distribution - 7.9%
- Open Flame - 6.1%

Source: National estimates based on NFIRS and NFPA survey, 1999 NFPA National Fire Escape Survey

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Projects

- | | |
|--|--|
| ▪ Arc Fault Circuit Interrupters (AFCI) | ▪ Heaters <ul style="list-style-type: none">• Portable• Fixed |
| ▪ Countertop Cooking Appliances | ▪ Panelboards |
| ▪ Clothes Dryers | ▪ Range Cooking Fires |
| ▪ Transient Voltage Surge Suppressors | ▪ Mattresses/Bedding (open flame) |
| ▪ Smoke Alarms <ul style="list-style-type: none">• Wireless Interconnect• Sound Effectiveness• Survey (alarms, sprinklers, fire extinguishers) | ▪ Gas Water Heaters |
| | ▪ Upholstered Furniture |
| | ▪ Candles |

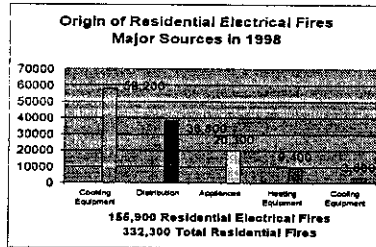
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Electrical Wiring Activities Outline

- Fire Incident Data
- Inspection/Correction
- Outreach
- New Technologies

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Residential Fire Losses

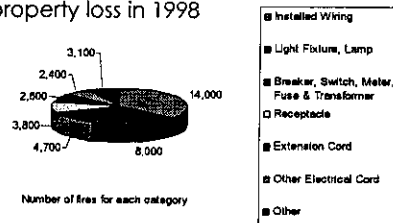


Source: 1998 Residential Fire Loss Estimates, U.S. Consumer Product Safety Commission - does not include arson related fires and all sources are not shown.

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Residential Electrical Distribution Fire Losses

38,800 Fires, 280 civilian deaths, 1,230 civilian injuries and \$680 million in property loss in 1998



Source: 1998 Residential Fire Loss Estimates, U.S. Consumer Product Safety Commission

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CPSC History of Addressing Wiring Fires

Progressive effort since the Agency's inception

- In the late 70's, CPSC staff investigated problems with aluminum branch circuit wiring
 - Issued *Repairing Aluminum Wiring* pamphlet to advise consumers
- In 1987, CPSC staff conducted a special study of electrical wiring fires (149 in-depth cases)
 - Fires occurred at highest rate in older homes
 - Improper modifications/installations also key factors

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CPSC History of Addressing Wiring Fires

- Home Wiring Project focused on older homes
 - Push for re-inspection of electrical systems in existing residences
 - Adoption of NFPA 73 *Electrical Inspection Code for Existing Dwellings*
 - Produced videotape demonstrations of incremental wiring repairs
 - Affordable steps to remove gross hazards
 - In 1994, sponsored study of technology for detecting and monitoring conditions that could cause electrical wiring fires (UL contract)

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CPSC History of Addressing Wiring Fires

- UL study found that arc fault detection appeared to be very promising, especially when added to an existing circuit protection device, e.g., a circuit breaker.
 - This can be further improved if combined with ground fault detection technology
- CPSC staff has had a longstanding involvement with the *National Electrical Code®*
 - including membership on Code-making panel 20 (now CMP-17)
 - membership on Code-making panel 2 since 2000

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Arc Fault Circuit Interrupters (AFCIs)

- By 1997, residential circuit breakers with arc fault were becoming commercially available

Figure 2.



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AFCIs

- CPSC staff submitted comment supporting proposals for 1999 *NEC* to require AFCIs for all branch circuits
- Compromise position was requirement for circuits supplying power to bedroom receptacles to have AFCI protection; delayed effective date of Jan 2002
 - Adopted in 1999 *NEC*
- All bedroom outlets required to have AFCIs in 2002 *NEC*

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Future

- Continue to support upgrades to the *NEC* through proposals for the 2005 Code
- Support AFCI technology for older homes
- Assess technology for distribution system components that could further reduce electrical wiring fires

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Data

- Dwelling fires related to electrical wiring systems from 1994-1998:
 - Annual averages - fairly level
 - Slight decrease in deaths and injuries
- Older homes at greater risk; new homes not immune.

Source: 1998 Residential Fire Loss Estimates, U.S. Consumer Product Safety Commission

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Plan to Obtain Better Data

- Fire Protection Research Foundation (FPRF) proposal on wiring
 - Evaluation of wiring systems in existing homes
 - Improving fire reports
 - Lab testing of old components

FPRF is a not-for-profit research foundation of the National Fire Protection Association (NFPA)

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Wire Safety Issues

- Aging, environmental stress
- Improper wiring practices
- Appliance/equipment load exceeds system design capacity

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Potential Wire Safety Issues

- Environmental Stress - Chafing, embrittlement, and corrosion
- Improper installation
- Mishandling of wiring during maintenance
- Accumulated damage as wire ages

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Current Practices

- Conformance with existing regulations, codes, and standards and revisions to them
- Training of inspectors and electricians
- Inspection, assessment, and maintenance of wire
- Engineering improvements
- Safety investigations
- Analysis of wire system data
- Exchange of technical information

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Current Technology Initiatives

- **Diagnostics:** non-destructive evaluation (NDE) techniques, inspection and detection technologies, and monitoring sensors for identifying wire system defects.
- **Failure Mechanisms:** causes and models of wire system failure and analysis of maintenance data.
- **Interconnection Technologies:** improved connectors, such as at terminations and splices in wire systems, training, management tools, and advanced distribution technologies, such as modular wiring, fiber optics, and wireless technologies.
- **New Materials:** new materials for wire system components, such as conductors and insulation, and novel approaches for wire systems such as the application of microelectronic technology.

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Common Issues

- Faulty wiring poses a risk to public health and safety; it may lead to failure of essential functions and even to smoke and fire.
- Managing aging wire systems is expensive and time-consuming.
- Inspection, testing, and maintenance of wire systems is a technical challenge.
- Most diagnostic procedures can detect only "hard failures" that result in serious deterioration of electrical integrity.
- Our knowledge about how wire systems age and how they fail is limited.

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Common Issues

- There are limitations to our electrical codes and standards.
- Wire systems are becoming more complex with increasing computerization of operations and of information about those operations.
- Wire system maintenance is very expensive and it is difficult to get funding to address wiring issues before a system break down.
- Current practices flow from – and are limited by – the current state-of-the-art of wire systems technology in terms of design, installation, diagnosis and maintenance.

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CPSC Actions

- CPSC-sponsored electrical distribution system fire investigations in the 1980s conclude older homes at greatest risk
- CPSC priority project in early 1990s develops strategies:
 - inspection code for existing residences
 - application of new technology to older residences
 - demonstrate practical safety improvements
- CPSC joins National Science and Technology Council "Wire System Safety Interagency Working Group" in 2000, a joint agency effort to look at aging and deterioration of wiring systems

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Wire System Safety Interagency Working Group

| | |
|------------------------------------|---|
| Consumer Product Safety Commission | National Aeronautics and Space Administration |
| Department of Commerce | National Science Foundation |
| Department of Defense | Nuclear Regulatory Commission |
| Office of the Secretary of Defense | In addition, the following organizations are represented on the WSSIWG: |
| United States Air Force | Defense Nuclear Facilities Safety Board |
| United States Navy | Office of Management and Budget |
| United States Army | Office of Science and Technology Policy |
| Department of Energy | National Partnership for Reinventing Government |
| Department of Transportation | National Transportation Safety Board (observer) |
| Federal Aviation Administration | |
| Federal Railroad Administration | |
| Federal Transit Administration | |
| US Coast Guard | |
| Food and Drug Administration | |

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Inspection Code for Existing Homes

- NFPA 73
- Complements the *National Electrical Code* (NFPA 70)
- Principal members include CPSC, UL, IEEE, NAHB, IAEI, NECA, NEMA, EEI
- New proposals are now being accepted, due early January

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CPSC Demonstrations

- Four old homes inspected and improved (Washington, DC area, Atlanta, St. Louis and Redlands, CA)
- TV-quality videos produced
- CPSC Guide Booklet "Home Wiring Hazards"
- Nationwide distribution of over 1000 sets of materials to state and local fire and electrical officials

USFA

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Current CPSC Activities Funded by USFA*

- Research Project on Residential Electrical System Aging - a cooperative effort with The Fire Protection Research Foundation of NFPA
- Government-owned housing: addressing older wiring with AFCIs
- Outreach efforts via media (publications, video tapes, presentations)
- Continuing efforts via codes and standards
 - NFPA 70 proposals for additional AFCI protection
 - NFPA 73, evaluation criteria for installed systems

*These activities are partially funded by the U.S. Fire Administration (USFA)

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Codes and Standards

Voluntary Standards Organizations

- Non-Voting members
 - ASTM
 - ANSI
 - UL
 - NEC

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Codes and Standards

- UL- STPs
 - AFCIs
 - GFCIs
 - Smoke Alarms
 - Leakage Current Protection Devices
 - Cord Sets and Power Supply Cords
 - Transient Voltage Surge Suppressors (TVSS)
 - Relocatable Power Taps
 - Circuit Breakers/Panelboards
 - Many appliances

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AFCIs

- CPSC Staff Evaluations
 - Efficacy
 - Nuisance Tripping
 - Consumer Usability
 - Cost vs. Benefit
 - Older Construction -Benefits 2:1 for homes 20 years or older
 - New Construction
 - 30 years life - benefits equal cost
 - 40 years life - benefits greater than cost
 - cost will decline

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NEC Proposals - AFCIs

- Existing Homes - CPSC Staff Priority area
 - Install AFCIs on all single phase 125V, 15A and 20A outlet circuits when service equipment is replaced (CPSC 2-124)
 - Minimally should accept, single phase, 125V, 15A and 20A bedroom outlets (IBEW 2-171)
- New Construction - Support
 - Bedroom outlets
 - Single phase, 125V, 15A and 20 A outlets AFCI protected (E-CH, AmeriTel Consulting)
 - Living areas - living and dining (NASFM)
- Against AFCIs in new construction - NAHB

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NEC Proposals - AFCIs

- Type of AFCI
 - Combination devices - new (SD)
 - Branch/Feeder - have field experience (other breaker manufacturers)
- Smoke Detectors/Alarms on AFCIs
 - No technical reason to exclude
 - Exclude smoke detectors (IBEW 2-147)
 - Allowed but not required

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NEC Proposals - AFCIs

- CMP 2 proposal 2-134a
 - A. Definition of AFCI, remains in Art. 210
 - B. Bedroom outlets, single phase, 125V, 15A and 20A, Combination type
 - Installed at origin of branch circuit except
 - Within 6 ft. of overcurrent protection, and
 - Installed within metal raceway or metallic sheath

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Staff Summary on AFCIs-NEC Proposals

- Priority in older homes when replacing service equipment on all single phase, 125V, 15A and 20A outlets
- New Construction
 - Support on all, single phase, 125V, 15A and 20A outlets
 - Installed at origin of branch circuit except
 - Within 6 ft. of overcurrent protection

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GFCIs

- Efficacy
- Nuisance Tripping
 - Early design design problem - fixed
- Consumer Usability
- Cost vs. Benefit
 - GFCIs are inexpensive
 - Benefits almost 2:1 over cost

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GFCI Field Failures

- 2001 NEMA study
 - ~10% Inoperable
 - Power but no shock protection
 - Miswired receptacles
 - Component failures
 - Surges
 - Few failed safely - no power

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CPSC Objectives - GFCIs

- Improve level of safety w/ GFCIs
 - Add "fail safe" or power lockout
 - Less likely to be incorrectly wired
 - Less dependency on consumer for monthly testing
 - More tolerant of electrical surges
 - More resistant to effects of humidity

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Consumer Perception of Lockout Technology

- Would consumers not use or test?
 - Consumer Testing is independent of perceived outcome of test
 - Consumers may test when visible
 - Consumers may test when reminded
- Consumers want device to fail safely and not provide unprotected power
 - Supported by IAEI comments, American Institutes for Research study (2000), CPSC Human Factors staff

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NEC Proposals - GFCIs

- CPSC proposal 2-47 - Add GFCI protection for unprotected dwelling unit receptacles
 - Sinks (IAEI)
 - Boat hoists
- CPSC proposal 2-70 - Add GFCI protection for receptacles in areas frequented by the public
 - CMP 2 accepted outdoor areas accessible to the public
- CPSC proposal 17-6 Add GFCI protection for vending machines
 - Receptacles
 - Installed in plug

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Staff Summary on GFCIs-NEC Proposals

- Add GFCI protection for unprotected dwelling unit receptacles, boat hoists, vending machines
- Add GFCI protection for receptacles in areas frequented by the public - both indoors and outdoors

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Transient Voltage Surge Suppressor Incidents

- Incidents with metal-oxide varistors (MOVs)
- Related to IBEW concern for safety on multiwire branch circuits
- An open neutral can cause an overvoltage on products with MOVs
- Creates potential for fire hazard

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Panelboards and Circuit Breakers

Data

- Electrical distribution system fires include those caused by panelboards and circuit breakers
- Review of incident data indicates panelboard fires likely occur when connections overheat between a circuit breaker and the panelboard's bus bar.

Technical Approach

- Obtain current/better field incident data by working with local fire investigators.
- Document designs of residential panelboards.
- Stress circuit breakers with thermal cycling to obtain failure mode data.
- Develop guidelines for investigators.

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Typical Panelboard Fire Incident
Chevy Chase, MD - March, 2002

- Single Family, Ranch Style, Finished Basement
- No prior electrical problems
- Fire occurred at approx. 4 a.m.
- 80 and 86 year olds escaped without injury
- Estimated property loss in excess of \$80,000

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To report unsafe products:

www.cpsc.gov

1-800-638-2772

Electrical codes and standards:

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dlee@cpsc.gov

301-504-7569